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REVIEW OF THE COLLECTION OF USSR PUBLISHED PAPERS "NEW IDEAS IN THE INVESTIGATION OF AEROSOLS"

N. A. Fuks

/N. A. Fuks is a member of the Scientific Institute of Fertilizers, Insecticides, and Fungicides. He has worked on the chromatography of hexachlorocyclohexane and penicillin, and has studied oil mists. The activity of N. A. Fuks and the work which he is reviewing in this instance are of interest because of chemical warfare and other military possibilities offered by results in this particular field./

The material for this handbook was selected from work done in this field by Soviet scientists in the last 2 or 3 years. The articles describe new phenomena, modern concepts, or new methods for the preparation and investigation of aerosols.

The classic method by which aerosol particles are ultramicroscopically counted, in an optically limited volume, is rather inaccurate due to the secondary light scattering by the particles and periodic interruption caused by their deposition on the inlet tubes and the walls of the cuvette. In view of this limitation, Deryagin and G. Vlasenko developed a continuous method for counting which registers "flashes" occuring as a result of particles crossing a narrow light pencil by moving along a tube towards the observer. This method permits detection of an extensive range of particle concentrations, namely, from 1 to 10^7 particles per milliliter. It is more accurate and more widely applicable than a similar method proposed by the US authors Gaker /Hack?/ and Konskiy /Russian approximation of American name/.

An article by A. Amelin deals with the mechanism of one of the most important instances of the formation of condensed aerosols, that which obtains upon mixing gases which have different temperatures and contain condensable vapors. Previously, it was possible to compute the amount of supersaturation only for mixtures where definite volumes of two gases were completely mixed. However, free gas streams can form all ratios of concentrations in the zone of mixing, and supersaturation dependent on these ratios varies accordingly. As shown by Amelin, the supersaturation, changing from point to point, can under certain conditions attain a maximum; and an aerosol is formed in the case where the maximum supersaturation

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is greater than the critical supersaturation. Amelin's conclusions open the way for calculating conditions leading to fog and mist formation over reservoirs, water-cooling towers, in waste gases, as a result of chemical processes, etc., and are of great practical value.

The general method for the preparation of condensed aerosols -- by heating vapors to sufficiently high temperatures and then mixing them with air -- cannot always be used. Some substances decompose when heated; others have rather high vapor pressures, making it impossible to create the necessary supersaturation. Because the general method is not universally applicable, N. Smirnov has advanced a condensation method based on deep local cooling. On the liquid over which the fog is to be formed, liquid air (or another low-boiling liquid) is poured, the liquid air assuming a speroidal state in the process. The vapors of the high-boiling liquid are cooled to the boiling point of the liquid air, and the resulting supersaturation leads to the formation of an aerosol. In the above manner, Smirov was able to produce fogs over such volatile liquids as pentane, etc.

Recent Soviet research has dealt with, but not fully explained, the problem concerning the effect of extraneous vapors on the stability of aerosols. Articles by I. Artemov point out that this effect is related to the change in the shape of aggregates of particles under the action of absorbed vapors. In cases where these vapors round out the aggregate (such rounding occurs as a result of the action of water vapor on the fog of ammonium chloride) the coagulation rate is decreased. Whenever the vapors promote the formation of elongated aggregates (as seen in the action of ammonia on the fog of nitrosodimethylaniline), the coagulation constant increases in line with the general theory for the coagulation of systems containing particles of irregular shape. Thus Artemov's work has fully clarified the effect under consideration.

P. Prokhorov and Deryagin investigated the causes of a recently observed phenomenon: repulsion when large drops of a liquid collide. They observed, for the first time, that drops did not coalesce even after prolonged contact when a sufficient difference between the pressure of the saturated vapor of the liquid and the partial pressure of the vapor in the surrounding area existed. By means of an ingeniously contrived experiment, they explained this phenomenon as the diffusion of vapor into the air space between the drops and the accompanying diffusion of the air displaced in this manner back into the interstitial space. This phenomenon does not occur in an atmosphere of saturated vapor, where the collision of drops results in their fusion. This work is of interest in connection with the modern theory on the formation of rain in clouds.

Articles by Deryagin, O. Todes, and F. Leyb on the theory of movement, growth and evaporation of drops of water and water solutions in a rising air current are of meteorological interest. They show the possibility of rain formation by means of condensation alone, not accompanied by the coalescence of drops.

Ye. Teverobskiy treats very important and, theoretically, very difficult problems concerning the diffusion and coagulation of aerosols in a turbulent atmosphere. Proceeding from the turbulence theory developed by Soviet mathematicians, the author derives an expression for the constant of turbulent coagulation of aerosols which (in relation to meteorological conditions) can in some cases exceed the constant of ordinary thermal coagulation. According to the author's experiments, this describes actually occurring conditions. Therefore, his conclusion differs from that of all other authors who concur in the assumption that turbulence does not appreciably increase the rate of coagulation of fine particles.

The remainder of Fuks' review criticizes technical errors, but points out the over-all value of the book as presenting notable achievements in work done by Soviet scientists.

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